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A Comprehensive Approach to Regulation of Natural Monopolies – Setting a Fair Rate of Return

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Abstract: One of the main questions, when designing the principles of the rate of return regulatory method, is "what is a fair rate of return". This question is important since a fair rate of return is essential for sustaining a financial stability of regulated companies and securing prudential new network investments. This paper tackles a problem of setting a fair rate of return in case of Croatia for four monopoly network activities, transmission and distribution in electricity and gas sector. A method used for setting a rate of return as defined in the regulatory sub-laws is a weighted average cost of capital (WACC). The goal of this paper is twofold: i) to validate the methodology prescribed by the regulator having in mind that the national economic, financial and regulatory environment has not yet reached its maturity, thus hindering consistent estimation of particular WACC parameters and ii) to analyze the results obtained for WACC. The findings of research indicate that significant improvements should be made concerning the overall regulatory policy and defined methodological approach.

Keywords: monopoly, regulation, WACC

JEL Classification: G18

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Introduction

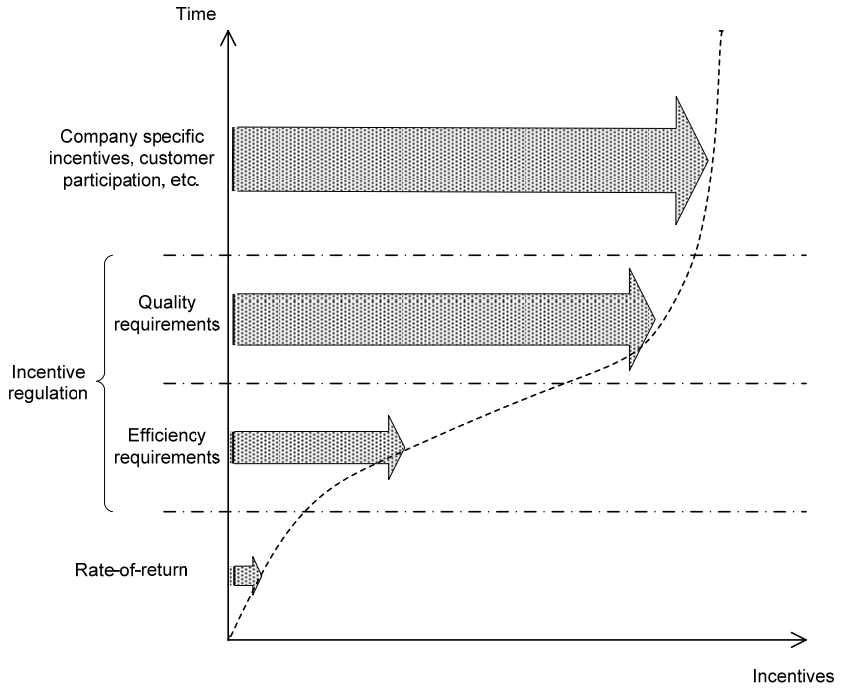
The consequences of energy markets' liberalization are the introduction of natural monopolies' regulation and establishment of national regulatory authorities. Namely, the process of liberalization in come countries had started before a regulatory authority was established. In addition, the first Electricity (1996) and Gas (1998) Directive did not insist on establishing an independent and competent national regulatory authority (NRA). In the course of time, it became obvious that an independent NRA is essential for proper functioning of the market. The objective of regulation is to secure efficient allocation of resources, improve efficiency of regulated companies and protect customers' interest in cases where competition is not possible or is not economically justified. The regulation of monopoly activities in electricity and gas sector in Croatia was introduced in 2001, when the first set of energy laws was passed, and furthermore in 2002, when the NRA was established. The NRA was in charge of regulating transmission and distribution activities in both sectors. Although the history of regulation started almost a decade ago, not much effort was put into development and implementation of the fully-fledged regulatory policy and tools. This fact still leaves much space for empirical analysis and discussions in regard to particular regulatory components, which in most developed countries, especially in the EU, have been thoroughly analyzed and discussed from the very beginning of introduction of economic regulation methods. The extensive overview of these methods, their individual elements and discussions on pros and cons could be fined in (Banovac and Štritof, 2005; Gelo and Štritof, 2005; Štritof and Krajcar, 2008).

In Croatia a chosen method of economic regulation of three monopoly activities, the electricity transmission, distribution and gas distribution, is the rate-of-return method (RoR). In the fourth activity, namely a gas transmission, a hybrid method was chosen. It comprises of elements of the RoR and the Revenue Cap method. Although the methods were chosen in 2006 they even at that time did not represent the state of the art in regulation of natural monopolies. However, Croatia is not an isolated case when it comes to choosing a regulatory method. Namely, in some other transition or ex-transition countries, where there is only one national company carrying out certain monopoly activity or the NRA is not competent and independent enough, the RoR or a combination of RoR and incentive method are chosen as well (e.g. Bulgaria, Estonia, Latvia, Bosnia and Herzegovina, Lithuania, Serbia) (ERRA, 2009).

From a point of view of regulatory principles' evolution pattern, the RoR represents an initial phase in the evolution (Fig. 1), thus leaving much space for further improvements of the regulatory regime. However, a challenge of setting an initial fair ground of NRA's practice causes potential regulatory risks. The risks could be reduced by carrying out substantial analysis and developing adequate regulatory

methods and tools, including data and information collection, processing and results' analysis. Moreover, such exercises should overcome an information asymmetry between regulated companies and the NRA.

Fig. 1: Phases in evolution of regulatory principles with a reference to incentives



Source: Vickers and Yarrow, 1998

When designing the RoR according to (Vickers and Yarrow, 1998) one of the main questions is "what is a fair rate of return". This question is important since a fair rate of return is essential for sustaining a financial stability of regulated companies and securing prudential new network investments. The authors considered solving this question in their research quite challenging especially in the environment of a country in transition with small electricity and gas markets and with an undeveloped understanding of regulatory processes, including a lack of well-grounded regulatory analysis.

The challenge is additionally strengthened by the fact that the methodologies (in a form of a by-law) passed by the Croatian Energy Regulatory Agency (CERA) set rather theoretical principles, lacking clear and straightforward explanation in which way a certain parameter should be calculated or which data (e.g. in regards to assets) will be accepted in a regulatory formula. Such approach leaves much space for

subjective interpretation and implementation by both parties - CERA and regulated undertaking. Additionally implementation of the methodologies, lacking transparent regulatory process, has not resulted in neither developing regulatory tools nor carrying analysis of the implications that the regulatory process *per se* has on parties involved.

The paper focuses on a single element of the regulatory method, namely on the rate-of-return. The primary aim is to present and discuss experience of estimating a fair rate-of-return for all four analyzed activities as defined by the methodologies in the environment (economic, financial and regulatory) which has not reached its maturity. The calculations and results presented in this paper are not an integral part of the regulatory processes already carried out in Croatia due to the fact that such detailed and substantiated estimates CERA has not performed so far. Therefore, the values for WACC and its components are neither known nor publically available. Such non-transparent regulatory behaviour is in contrast with the principles of good regulation demonstrated in (Green et.al., 2006).

Therefore, the estimates shown in the paper are the result of authors' own research. The findings of research additionally indicate that it is essential to develop and apply a consistent, properly and clearly defined method for calculating a well-grounded rate of return as an integral part of regulatory process. Thus, decreasing the ambiguities which could occur during the regulatory process, especially in circumstances in which a development of regulatory policy is in its initial phase.

A structure of the paper is as follows. The second Section gives an overview and economic analysis of Croatian electricity and gas sectors, in particular of energy undertakings analyzed in the paper. The third Section provides a legislative framework for regulation of monopoly activities. In the fourth Section the method used for calculation of a rate-of-return is presented. The calculations and results are given in the Section five, which is followed by the sixth Section in which thorough discussion is carried out and conclusions are drawn.

Overview of Electricity and Gas Sector

The energy sector is very important for the economic development of Croatia, which additionally increases the importance of CERA's role in monitoring and regulating the energy markets.

Although the sector employees roughly 2.3% of all employees in Croatia (MINGORP, 2009), according to (MINGORP, 2009) the total income of the sector in 2008 represents 22% in GDP. At the same time the consolidated result shows that a net profit was less than 1% of total income (Table 1). One can notice a huge discrepancy between the total income and the resulting consolidated profit. Such discrepancy is

not acceptable for a capital intensive sector in which large investments are expected. If these figures are compared to figures from telecom sector, where in total the leading operators (mobile and fixed) realized the income of 8 billion kunas and 2 billion kunas net profit, one comes to the conclusion that urgent measures and actions are needed to be taken in the energy sector making it more profitable.

By a notion energy sector four sectors are encompassed: electricity, gas, district heating and oil. The electricity sector is dominated by one incumbent company - Hrvatska elektroprivreda (HEP Group). The owner of all assets in the Group is a mother stock company HEP. The primary business of HEP Group includes a whole chain of electricity activities (production, transmission, distribution, supply and trade). Its share in overall state production is 99% and it is the only company that carries out transmission and distribution activity. It is fully state owned and its daughter companies are legally unbundled. The available generation capacity of HEP Group is roughly 4 GW. This capacity includes 17 hydro power plants (2.09 GW), 7 thermo power plants (1.56 GW) and 50% of the nuclear power plant Krško located in Slovenia (0.35 GW) (HEP, 2008). The operator of transmission network is HEP-Operator prijenosnog sustava ltd (HEP-OPS), while the operator of distribution network is HEP-Operator distribucijskog sustava ltd (HEP-ODS).

Table 1: Data on the state of the energy sector

Company /sector	Income	Net profit	Assets	Network length	Employees
	billions kunas*			km	(000)
Energy sector (total)	74	664	-*	-	34
HEP Group***	9.85	308	33	-	14.5
HEP – OPS	1.0	61	4.5	7.000	1.2
HEP - ODS	3.5	118	15	100.000	9.6
Plinacro	0.56	115	2.7	2.110	0.55
GPZ	0.4	3.4	1.7	3.700	0.5

* 1 EUR=7.4 kunas
** N/A
*** Including electricity business only
Source: MINGORP, 2009; HEP, 2008; Plinacro, 2008; GPZ, 2008

The income of HEP Group in 2008 resulting from electricity business reached 83% of total HEP Group income (all business activity included), while the net profit was 308 million kunas (consolidated profit of the Group was 31 million kunas). In the same year the sale of electricity reached 17.7 TWh and HEP's production was 14.3 TWh.

Regarding business operation of monopoly activities carried out by HEP-OPS and HEP-ODS and regulated by the CERA, it is worthwhile to mention that HEP-

OPS's total income in 2008 was about 10% of HEP Group income (only electricity business) while its net profit was about 20% of HEP Group's net profit (Table 1). HEP-OPS operates transmission network (including 400kV, 220 kV and 100 kV assets) (HEP, 2008). In the same year the operating income of HEP-ODS was about 35% of HEP Group income and the net profit was about 40% of HEP Group net profit. HEP-ODS operates distribution network (HEP, 2008). A significant share of distribution asset value results from customers' participation through connection fees due to a deep connection fee approach. This fact had also an impact on authors' analysis and calculations.

A situation in the gas sector, compared to electricity sector, seems to be more complex, especially in regard to a number of companies and ownership structure, which enables a potential design of complex regulatory policy. Moreover, in this sector the ownership unbundling between market and regulated activities within the incumbent company INA-Industrija nafte was already carried out in 2002. Nowadays, INA is engaged in production and trade of gas and oil. Its ownership is mixed (44.84% state, 47.26% Hungarian company MOL and 7.90% private and institutional investors). Since the first phase of its privatization in 2006, INA was listed at the Zagreb Stock Exchange (ZSE) and till today it is the only company from the gas sector which has been quoted. The second company from the energy sector which is quoted at the ZSE is JANAF. JANAF carries out transport of oil and it is predominantly state owned.

Natural gas is produced in 17 inland gas fields and 6 sea fields. Domestic production covers 61% of consumption needs in Croatia (in 2008 consumption was 3.2 billion m^3) (INA, 2008).

A gas transmission operator Plinacro ltd was separated from INA in 2002 and today is fully state owned. Plinacro owns and operates transmission network (Plinacro, 2008). The network length increases significantly each year due to the accelerated gasification of certain areas and the fulfilment of the national development and construction program whose planned investments are 500 million € by 2011. Due to this program Plinacro's net profit was about 21% of total income in 2008. Such significant net profit should also results from the CERA's regulatory policy.

A gas distribution is carried out by 37 local distribution companies which operate 17.7 thousand kilometres of distribution network (GPZ, 2008). The ownership of the networks is various – private, state owned, municipality owned, mixed. A share of five biggest distributers is 65%. The biggest distributor is Gradska plinara Zagreb (GPZ) which covers the area of the capital and several surrounding areas. Its owner is the city of Zagreb and its share in overall distributed quantities in 2008 was roughly 33% (440 million out of 1.3 billion m^3) (GPZ, 2008). A fact, worthwhile to mention and relevant for further calculations, is that GPZ has no debt in

financial statements, primarily due to historic local government's policy. Namely, a construction of local distribution network was financed solely from connection fees and profit, no loans were taken.

Regulation of Monopoly Activities

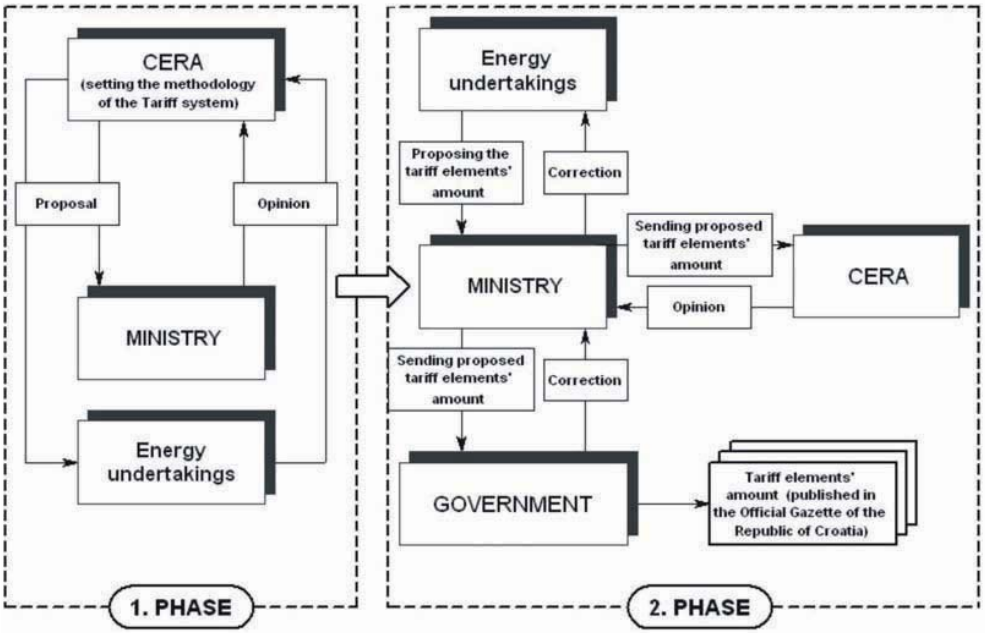
A general framework for development of regulatory policy and methods has been gradually established since 2001 when a set of first energy laws was passed. This set of laws defined that the NRA was in charge of setting the electricity transmission and distribution tariffs as well as the gas transmission tariff, while the gas distribution tariffs were in competence of local authorities. At that time a regulatory method for setting electricity transmission and distribution tariffs was not defined (unknown), meaning that it was not recognizable which regulatory method was applied (e.g. rate-of-return, incentive regulation, etc.). Such undefined approach was not an isolated case, since in some other European countries (e.g. France, Italy, Germany), in the first phases of market opening and developing of regulatory policies and methods, the applied regulatory methods were also undefined (Štritof and Krajcar, 2008). The only activity for which a regulatory method, at that time, was to a certain extent defined and applied from the very beginning of introducing regulation was gas transmission. The applied method was a combination of RoR and revenue cap method.

Further development of the legal framework and its harmonization with the 2003 EU *acquis* (the Electricity and Gas Directive and regulations) resulted in passing the second set of energy laws in December 2004, which included:

- Energy act,
- Electricity market act,
- Gas market act,
- Act on production, distribution and supply of thermal energy and
- Act on the regulation of energy activities.

To a certain respect, some of solutions envisaged with the new set of laws were a step backwards, especially in regard to activities of electricity transmission, distribution and gas transmission. New amendments of the Energy act defined that the CERA was in charge of setting methodologies for calculating network tariffs, both electricity and gas, while the Government was responsible for setting respective tariffs calculated according to the methodology passed by the CERA. Thus the NRA lost the responsibility for setting tariffs (Fig. 2) (Banovac et al, 2007).

Fig. 2: Procedure for setting methodologies and tariffs



Source: Banovac et al, 2007

During year 2006 and 2007 the CERA passed four sub-laws, so called tariff systems, which define a regulatory method for calculating tariffs for all four respective activities (CERA 2006; 2007; 2010):

1 Tariff system for electricity distribution, without the amounts of tariff items;
2 Tariff system for electricity transmission, without the amounts of tariff items;
3 Tariff system for natural gas distribution, without the amounts of tariff items;
4 Tariff system for natural gas transmission, without the amounts of tariff items.

In the first three tariff systems a light-handed RoR method was chosen. Its main characteristic is that the allowed revenues are set by analyzing the costs of a particular regulated company and not by comparing these costs with the costs of similar regulated companies. The RoR standard formula used for calculating the allowed revenue on yearly basis in the mentioned tariff systems is as follows:

$$R_t = OPEX_t + RAB_t \cdot WACC_t + D_t \tag{1}$$

where

R_t is the allowed revenue in year t;
$OPEX_t$ are operating costs in year t;
RAB_t is the average value of regulated asset base in year t;

$WACC_t$ is the weighted average cost of capital in year t and
D_t is depreciation in year t.

The main drawbacks of this method are the lack of incentives for efficiency improvements and potentially too excessive rewards which could result in over-capitalization. These drawbacks have been greatly discussed and criticized by many authors (Jamasb and Pollitt, 2003; Irastorza, 2003; Bernstein and Sappington, 1999). These discussions and analysis resulted in designing more complex and advanced regulatory methods whose aim was a reduction of monopoly inefficiencies. Moreover, due to the fact that cost reductions could jeopardise a level of quality of supply, further developments were directed toward ensuring sufficient quality of supply (Štritof and Krajcar, 2008). However, the analysis and discussions in regard to the elements of more complex regulatory methods go beyond a scope of this paper.

An element of RoR method which presents one of the origins when it comes to regulatory involvement is a rate of return. This element, additionally, requires not only familiarity with companies' costs and business activities, but also understanding of a national and international socio-economic environment, consequently, making it more challenging for setting its justified level. The tariff systems, except Tariff system for natural gas transmission, define the WACC approach as a method for calculating a fair rate of return. A methodological basis for determination of WACC has been rooted in modern finance theory. As the theory evolved, the asset pricing models have been developed accordingly. The WACC approach is used by majority of NRAs when setting the rate of return (Karotamm, 2010; Frontier Economics, 2005).

In the Croatian case, especially in respect to the allowed revenue setting, the CERA has not yet carried a thorough analysis of the WACC estimates, neither has analysed the implications of rate of return that was actually applied after the Government, as a final instance, had set the level of network tariffs. This fact increased a regulatory risk for the companies, although the RoR is considered as a low regulatory risk method for them while most of the risk lies with consumers. Namely, companies in a regulatory process have incentive to file high level of costs primarily capital (CAPEX), accepted in a regulatory asset base on which a rate-of-return is applied. Such high level of costs leads toward over-capitalization, which results in high quality and prices above optimal (Ajodhia and Hakvoort, 2005).

Additionally, such a non-transparent approach had an impact on the answer to the question "what is a fair rate of return in the Croatian case", thus leaving it unanswered for all four monopoly activities.

Method Used for Calculating a Rate of Return

In this paper four activities are analyzed. For three activities, as mentioned above, a methodology for calculating WACC is defined. For the gas transmission a methodol-

ogy for calculating WACC has not been defined, although the Tariff system per se stresses that the regulatory method is the revenue cap method. Moreover, a methodological basis for calculating other regulatory parameters has not been set as well. Due to the fact that the WACC for gas transmission could not be estimated according to the methodology defined in the respective Tariff system, the calculation of this activity WACC for the purpose of this paper follows the calculation principles of other three activities.

The tariff systems define a method for calculating a post-tax WACC:

$$WACC_{post-tax} = r_e \cdot \frac{E}{E+D} + r_d \cdot \frac{D}{E+D} \cdot (1 - \frac{T}{100}) \quad (2)$$

where
D is the total debt (kn);
E is the total equity (kn);
r_d is the cost of debt (average interest rate on liabilities) (%);
r_e is the cost of equity (%) and
T is the corporate tax rate (%).

The cost of debt is defined as the average interest rate on liabilities. However, a very common regulatory approach in estimating the cost of debt is based on estimating the risk free rate on which country specific debt premium is added (Frontier Economics, 2005).

For calculating the cost of equity the most widely used regulatory approach is chosen, as elaborated in (Brounen et al, 2004). Namely, the cost of capital in tariff system is estimated using the Capital Asset Pricing Model (CAPM):

$$r_e = r_f + \beta \text{ x } (r_m - r_f) \quad (3)$$

where:
r_f is the risk free rate;
β is the measure of relative (or non-diversifiable) risk of the company or industry
r_m is the expected return on the market and
$(r_m - r_f)$ is the market risk premium.

A parameter in the CAPM model which seemed to be the most requiring for estimating is the Beta coefficient. Namely, when regulated companies are not quoted as explained in Section 2, according to (Frontier Economics, 2005) direct estimation of the equity Beta is not possible. Therefore, its calculation requires further methodological basis, which is not sufficiently elaborated in the tariff systems.

The authors in their estimates chose to calculate the coefficient Beta based on the Betas of a set of comparable quoted companies at the ZSE, bearing in mind at the same time that such estimates could lead to much higher Betas than those used by the EU regulators as shown in (Energy Regulatory Office, 2009; Karotamm, 2010).

Namely, NRAs in the EU, especially those from the ex-communist regime, set Betas by comparing values of other regulatory regimes or in a reverse procedure, meaning setting acceptable level of WACC (influenced by political or private interests) prior to defining Beta. The authors wanted to avoid such approaches and chose the approach which leans strictly to the Croatian stock market, neglecting at the same time the drawbacks of this approach. The estimates are done purely for academic purpose. In a real regulatory process, a value for WACC and Beta is a compromise which should result from reasoned negotiations.

In the chosen approach it is necessary to define:

a) the choice of the set of comparators and

b) the choice of estimation method.

Regarding the choice of comparators the authors chose to carry out comparison with two energy companies (INA and JANAF) quoted at the ZSE as mentioned in the Section 2. Such approach was chosen in order to reflect the Croatian situation as undoubtedly as possible, not allowing the influence of other countries situation, neither through the Betas they used in regulatory methodology nor through the Betas of companies listed at other stock exchanges.

Regarding the second choice, the choice of estimation method, two estimates were used – daily and weekly movement of stocks compared to the ZSE index CROBEX. Both time estimates were used due to the underdeveloped national financial market and its low liquidity on one hand. On the other hand such estimates according to author's opinion can increase the quality of results obtained for two quoted companies.

Firstly, the equity Beta (or so called levered Beta) of comparing companies was calculated. The equity Beta of comparable companies is the covariance of the stock-return with the market-return. It is calculated (or reported) Beta for stock. The estimation method is based on whether days or weeks:

$$\beta_{levered} = \frac{\mathrm{cov}(r_i, r_M)}{\sigma_M^2} \tag{4}$$

The next step envisages calculation of asset Betas (or so called unlevered Beta) of comparable companies, thus removing effects of capital structure of particular company:

$$\beta_{unlevered} = \frac{\beta_{levered}}{1 + (1 - T) * \frac{D}{E}} \tag{5}$$

where E is a market value for equity and D is a debt of comparing companies (INA and JANAF). Asset Betas of comparable companies obtained in this way is the best estimate of asset Betas of analyzed companies in Croatia (HEP, Plinacro, GPZ) carrying out transmission and distribution activities in gas and electricity sector.

Finally, the equity Betas (relevered Beta) for all four monopoly companies is calculated, applying capital structure (share of equity and debt from respective book values) of each individual company:

$$\beta_{relvered} = \beta_{unlevered} \cdot (1 + (1 - T) \cdot \frac{D}{E}) \tag{6}$$

The values for Betas obtained following the above mentioned steps are given in Section 5.

Formula (2) envisages calculation of a post-tax WACC as defined in the respective tariff systems. However, in other Central and Eastern European countries as demonstrated in (Karotamm, 2010) the pre-tax WACC is calculated. Afterwards this pre-tax value is used for estimating a return on regulated assets and finally allowed revenue. A standard formula for a pre-tax WACC is:

$$WACC_{pre-tax} = g \cdot r_d + \frac{1}{1-t} \cdot r_e \cdot (1 - g) \tag{7}$$

where g is gearing and t is corporate tax rate (T/100).

In this case the cost of equity is multiplied by a tax "wedge". A tax wedge in Croatia is 25%.

Also some regulators due to tax issues prefer to use "vanilla" WACC:

$$WACC_{vanilla} = g \cdot r_d + r_e \cdot (1 - g) \tag{8}$$

The assessment of corporation tax liabilities for regulated company, in the "vanilla" WACC, is managed as a cash-flow item and added to the operation costs of a business (Oxera, 2005).

According to (Oxera, 2005) interest payable on debt is already factored into taxable profit therefore post-tax WACC should not be used in the determination of the prices which is in contrast to a wording of Croatian methodologies.

According to authors' opinion, it seems that a formula for the post-tax WACC, as it is defined in the tariff systems, is incorrect and the values obtained for WACC in this way are too low. Namely, when a value for WACC is applied in further calculations for the allowed revenue, these calculations are made for the parameters which precede taxation. If a value for post-tax WACC is calculated rather than for pre-tax WACC, according to (Independent pricing and regulatory tribunal, 2002) a tax should be e.g. included in expenditure cash flow rather than in WACC. However, the Croatian regulatory principle and methodology does not envisage inclusion of the tax in the expenditure cash flow or any similar solution. Due to the improper and incomplete methodology for setting WACC and inclusion of tax in estimates, the allowed regulated revenue is set at the lower value than it is justified, if calculations follow tariff systems' principles.

Calculation and Results

In this Section calculations of the WACC for four activities and respective four companies are presented:

1 electricity transmission (HEP-OPS),
2 electricity distribution (HEP-ODS),
3 gas transmission (Plinacro) and
4 gas distribution (GPZ).

Calculations are based on the analysis of energy sector, its legal and regulatory framework, as well as on the methodology described in previous Section. For the calculation of the cost of equity (2) using CAPM approach three parameters are important the risk free rate, the market risk premium and the coefficient Beta.

For the risk free rate the long-term securities of the Republic of Croatia were analyzed since they are considered as the most secure investment for which the state guarantee. The analysis is based on the 10-year bonds, including bonds issued in Euros and kunas by the Ministry of finance and the bonds issued in Euros and US dollars by the Republic of Croatia. All 10-year bonds whose maturity has not been reached are shown in Table 2. According to (Ministry of Finance and Government of Republic of Croatia, 2010) a basis for carrying out the risk free rate analysis in this way is a characteristic of regulatory policies in other countries as well.

Table 2: 10-year bonds issued by the Ministry of finance and the Republic of Croatia

Issuers	Currency	Coupon	Maturity
RHMF 12	EUR	6.875%	23.05.2012
RHMF 14	EUR	5.500%	14.06.2014
RHMF 15	EUR	4.250%	14.07.2015
RHMF 20	EUR	6.500%	05.03.2020.
RHMF 15	HRK	5.250%	15.12.2015.
RHMF 17	HRK	4.750%	08.02.2017.
RHMF 20	HRK	6.750%	05.03.2020.
CROATIA 2011	EUR	6.750%	14.03.2011
CROATIA 2014	EUR	5.000%	15.04.2014
CROATIA 2019	USD	6.750%	05.11.2019.
CROATIA 2020	USD	6.625%	14.07.2020.

Source: Ministry of Finance and Government of Republic of Croatia, 2010

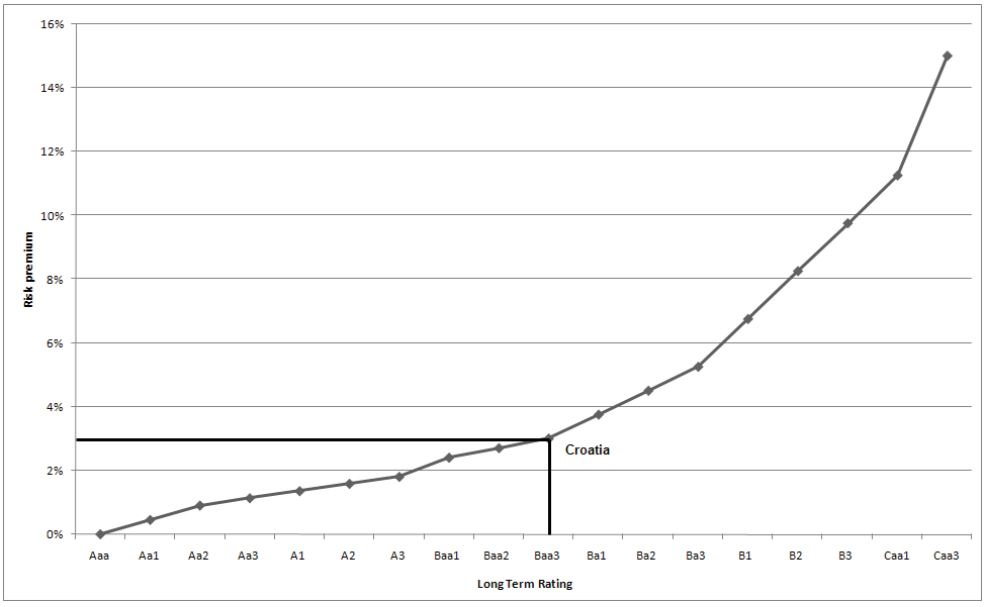
The result of analysis shows that the yield of 10-year un-matured bonds is 6.5%. This result could be compared with some other recent research and analysis. According to (RBA) the yield on 10-year Croatian bonds is about 6.5%. Therefore, in

further calculations this value was taken as the risk free rate. In the same source the yield analysis of 10-year bonds in other countries is given. A current yield in Germany is 3% (maturity on July, 4th of 2020) and in the USA 3.5% (maturity on May, 15th 2020). The yield of the Croatian bonds used as the risk free rate could be compared with the yields of bonds issued in local currencies by some other CEE countries (new EU members) whose economy in similar situation as in Croatia, e.g. Czech Republic 3.75%, Hungary 7.5% and Poland 5.25% (RBA, 2010a).

The second CAPM parameter, the market risk premium, was estimated using a credit rating of Croatia determined by Moody's as Baa3. According to the analysis and research carried out in (Demodoran, 2010) the market risk premium which corresponds to the respective credit rating equals 3%. Fig. 3 shows a relationship between a country long term credit rating and risk premium.

The value of 3% could be additionally challenged if the yields of 10-year bonds issued by Croatia and the USA are compared. Namely, as previously mentioned, the Croatian bonds yield is 6.5% while for the USA bonds yield is 3.5%. A difference in yields represents a country risk premium for Croatia above the USA's risk.

Fig. 3: A relationship between the country long term credit rating and the risk premium



Source: Demodoran, 2010

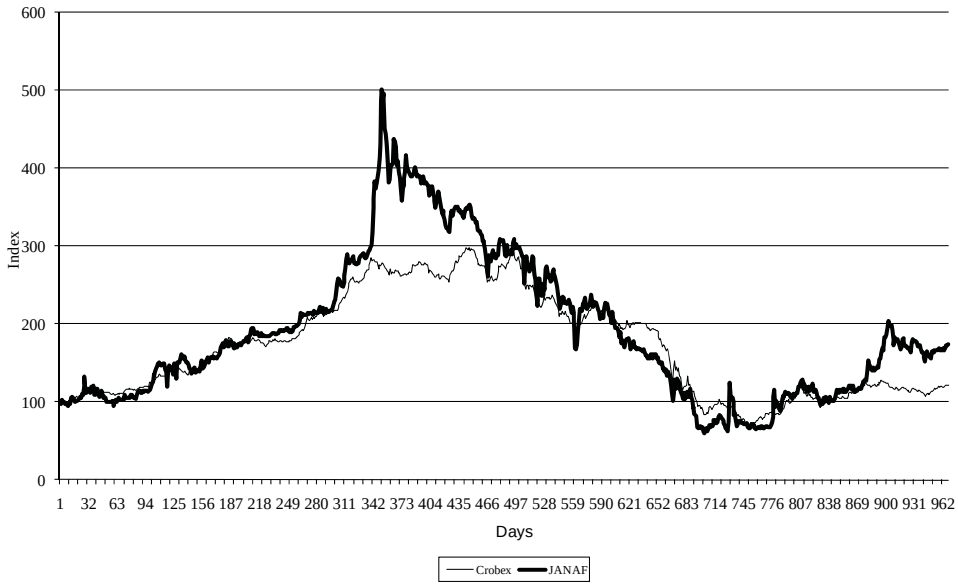
Countries with no risk premium are Australia, Canada and most of the EU-15 countries, while countries with high risk premium are Ecuador, Moldova and Ja-

maica. Countries whose risk premium is close to Croatia's are e.g. Brazil, Bulgaria, Columbia, Latvia, Romania etc.

The third parameter in the calculation of the cost of equity is the coefficient Beta, namely equity Beta. This parameter presented the biggest challenge in authors' analysis and calculations due to, primarily, the lack of energy companies listed at ZSE and the lack of historic regulatory research and practice. As mentioned in Section 4 a comparison with two energy companies (INA and JANAF) quoted at the ZSE was carried out using two estimates, daily and weekly movement of stocks compared to the ZSE index CROBEX. A share of INA stocks in total stock market was 2% in 2007 and 2009 while in 2008 was 6%, whereas a share of JANAF stocks in total stock market was between 0.1% in 2008 and 0.6% in 2009.

For calculation of the levered Beta for INA a period in between December 1st 2006 and February 1st 2010 was used (769 days and 166 weeks), while for JANAF a period in between June 28th 2005 and January 2nd 2010 was used (958 days and 232 weeks). Fig. 4 shows a movement of daily index for JANAF and the Crobex based on (ZSE, 2010). The first day is presented with 100.

Fig. 4: Movement of JANAF's daily index and Crobex (1st day =100)



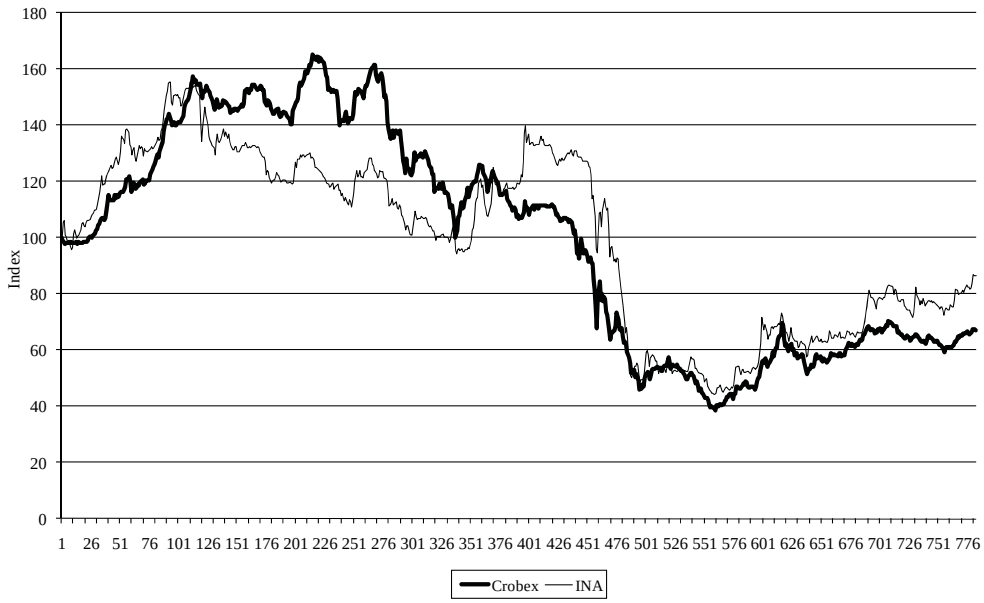
Source: ZSE, 2010

During the first listed year a movement of JANAF's stock followed the Crobex, after that there was a significant discrepancy in trends lasting for about six month after which the situation stabilized and trends were again harmonized.

Fig. 5 shows the movement of INA's daily index and Crobex (ZSE). The analysis shows greater deviations between INA's daily index and Crobex compared to the movement of JANAF's stock in comparison to Crobex. Trends shown in Fig. 4 and Fig. 5 are additionally supported by calculating a levered Beta on daily and weekly bases based on (INA, 2008; JANAF, 2008) for both stocks (Table 3).

Results for INA and JANAF (natural monopoly for oil transport) shown in Table 3 are actually in contradiction to theory which assumes that natural monopolies' stocks are more stable and fluctuate less than stocks of companies which are not natural monopolies. However, the results could be explained by the fact that INA has actually a monopoly in gas business (a wholesale of gas) and thus influences significantly the whole gas business in Croatia. On the other side, it should be also beard in mind that INA is commodity oriented (both gas and oil), rather than networks oriented, which has an impact on the result for Beta. Additionally, a result for mostly state-owned company JANAF is a consequence of insufficiently developed national financial market. In order to alleviate results from Table 3 all values for both companies are taken into further calculations.

Fig. 5: Movement of INA's daily index for INA and Crobex (1 day =100)



Source: INA, 2008; JANAF, 2008

Table 3: Betas for INA and JANAF

Company	Levered Beta		Unlevered Beta	
	Beta - days	Beta - weeks	Beta - daily	Beta - weekly
INA	0.644	0.832	0.477	0.616
JANAF	0.899	1.137	0.870	1.101

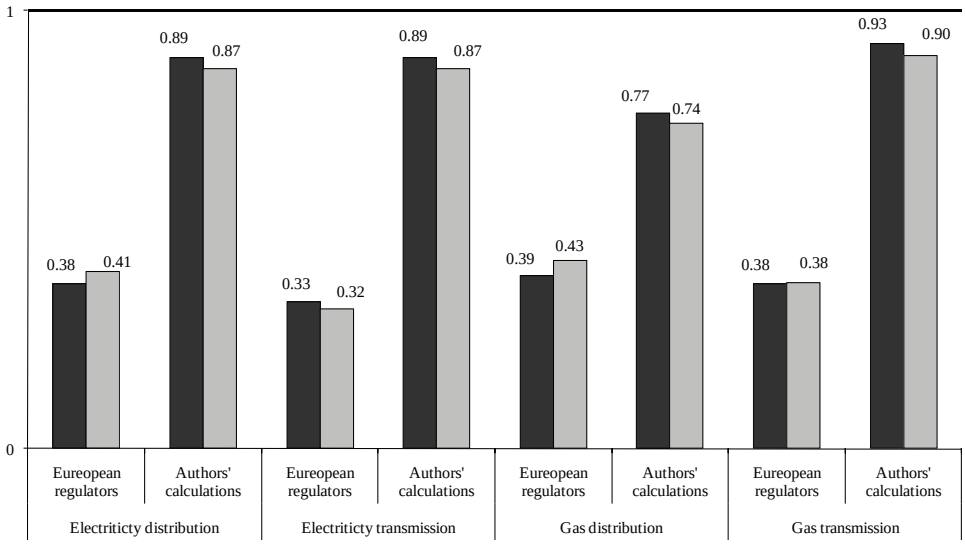
Source: Authors calculation based on ZSE, 2010

The unlevered Beta is corrected for the debt-equity ratios (Formula 6) for both companies.

Applying formula (6) a final result for the relevered Beta for companies in all four monopoly activities is shown on Fig. 6. The values are shown for the median and average relevered Beta obtained from daily and weekly values of the unlevered Betas for INA and JANAF. In further calculations the median Betas are used, although there are no significant differences between the average and median Betas.

Fig. 6 also shows estimates for average and median levered Betas applied in some EU regulatory regimes (Energy Regulatory Office, 2009). A significant difference between data for Croatia and other regulators results from the fact that authors in their calculations used data from a single national financial market and companies listed on a single domestic market, while the practice of other regulators is very often to make a comparison with companies worldwide, or to apply the estimates of Betas (average or median) from a number other regulatory regimes.

Fig. 6: Average and median Beta for four activities - Croatia vs EU countries



Source: Energy Regulatory Office, 2009

According to tariff systems a parameter cost of debt is defined as a ratio between the interest costs for short and long term loans and bonds (data from the profit and lost statements) and total liabilities resulting from respective loans and bonds (data from the balance sheets). The methodology (Section 4) does not require calculation of the weighted average interest cost, which would be a complex and requiring exercise in case when data is not available in publically published companies' reports. Data used in calculation of the cost of debt for HEP's companies (HEP, 2008) and Plinacro (Plinacro, 2008) are shown in Table 4.

Table 4: Data used in calculation of the cost of debt for HEP's companies and Plinacro

Liabilities	Amount (000 kunas)	
	HEP	Plinacro
Bonds	1.197.070	0
Long term credits	2.963.030	659.158
Short term credits	1.118.344	0
Total liabilities	5.278.444	659.158
Financial expenses (interest rates)	286.797	31.564
Average cost of debt	5.42%	4.78%

Source: HEP, 2008; Plinacro, 2008

In case of GPZ the cost of debt equals zero, as explained in Section 2.

A parameter in calculation of the WACC which significantly influences results is a share of debt and equity in respective monopoly activities. Data for these two parameters was taken from the company's 2008 annual reports. However, the optimal ratio of debt and equity for HEP-OPS and HEP-ODS was estimated due to the fact that a fully-fledged unbundling within HEP Group has not been carried out yet which influences transparency and accuracy of the book values. More thorough discussion on this issue could be found in (Štritof et al., 2009) Therefore, in case of HEP's companies two estimates were done:

a) Version 1 – the ratio of debt and equity on the HEP Group level (data form financial statements) and
b) Version 2 – the estimated ratio.

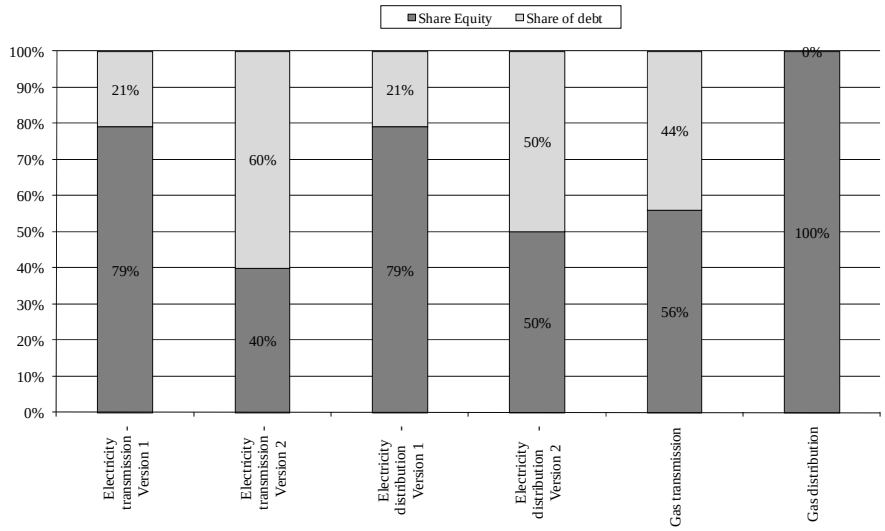
A ratio in Version 2 is a result of authors' research which encompassed the analysis of the best regulatory practice in setting ratios, analysis of passed and planned investments of HEP-OPS and HEP ODS, taking into account especially a fact that a significant portion of HEP- ODS funds for investments come from the collected connection fees (a deep connection fee approach is applied). In addition for both activities it is to be expected that in future a grater share of new loans will be taken, influencing a share of debt in WACC calculations. Primarily, due to the fact that in

last couple of years investments in HEP's networks declined significantly (CERA, 2010) although the age of network assets urge for new investments.

However, as long as a complete unbundling of assets and liabilities is not carried out within HEP Group, recognising them in respective balance sheets of daughter companies (HEP-OPS and HEP-ODS), it will not be possible to define exactly a gearing rather the estimates will be used as done in this paper.

The share of debt and equity in respective monopoly activities based on (HEP, 2008; Plinacro, 2008; GPZ, 2008) is shown in Fig. 7.

Fig. 7: The share of debt and equity in respective monopoly activities

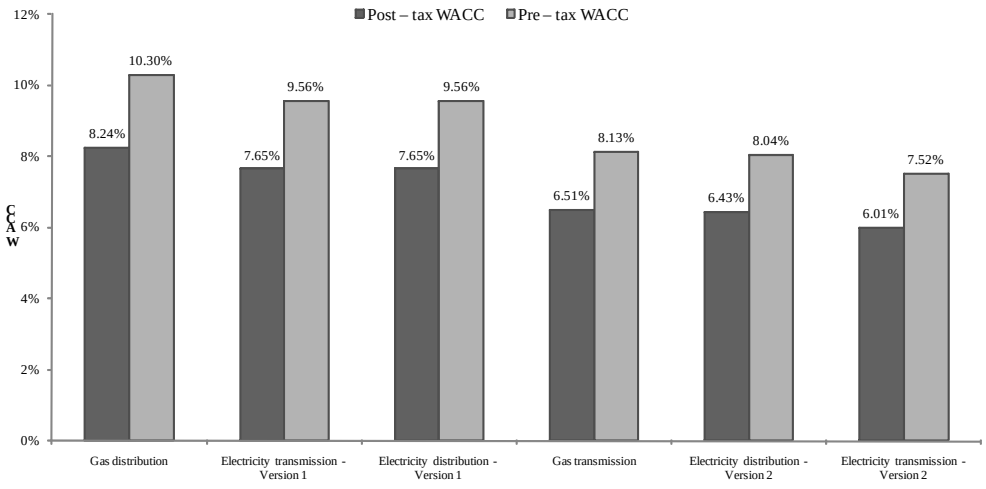


Source: HEP, 2008; Plinacro, 2008; GPZ, 2008

A parameter which is also taken into account in formula (2) is a tax on profit. In Croatia it equals 20% (Croatian Parliament, 2010).

Fig. 8 shows the results for post and pre tax WACC for the respective monopoly activities. A range goes from the most risky activity, gas distribution, to the least risky activity, electricity transmission. It is important to emphasise that these values could not be compared with the values really applied in the Croatian case as previously said. The main reason for this is the fact that the Government sets tariffs for monopoly activates. These tariffs are often not the ones resulting from methodologies, proposed by the energy undertaking and considered by the CERA, but are rather a result of political decision. After the Government makes a decision on tariffs, recalculation of regulatory parameters, including a rate-of-return is not done. Therefore, one can not say what level of WACC is really set at a moment.

Fig. 8: Results for nominal pre-tax and post-tax WACC for four monopoly activities



Source: Authors calculation

The authors' results imply that different WACC values are primarily determined by a ratio between equity and debt of respective companies. WACC for GPZ is the highest due to the fact that GPZ does not have any debts toward credit institutions. Nevertheless, from the stand point of business riskiness gas distribution business is more risky than gas transmission or electricity transmission so it is logical to have higher WACC. There are several reasons for such statement. Namely, in Croatia operates 37 gas distributors and only one gas transporter. Distribution is riskier since planning the consumption of each distributer is more uncertain than planning the consumption of total national consumption as it is done in a case of transmission. Namely, gas distributors compete with other sources of energy (wood, electricity, oil, coal). On the other hand gas transmission is purely monopoly activity with limited market risk. Consequently, an utilisation of assets is unpredictable as well. In addition, in 2008 most gas distributors were also gas suppliers and about 80% of their total gas price was a transfer cost (a wholesale price).

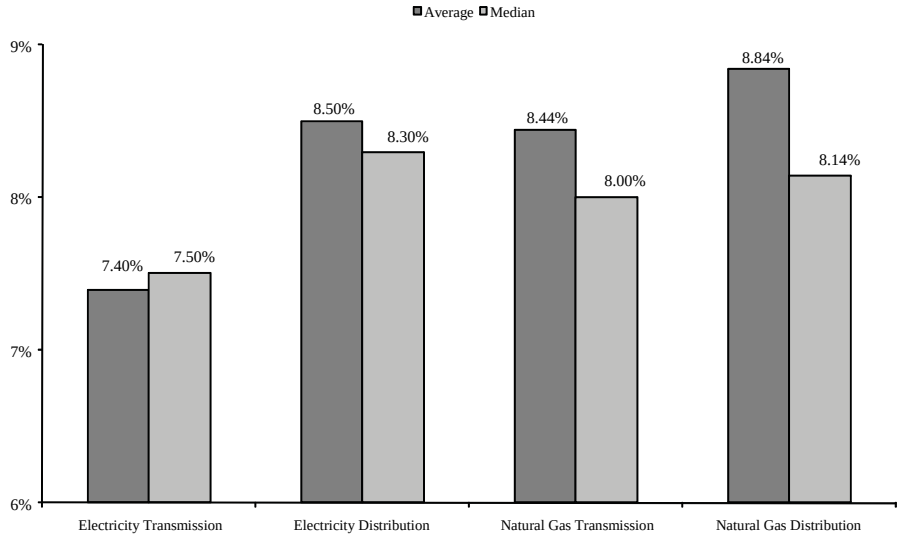
Electricity and transmission in Version 2 have the lowest WACC values due to the greatest assumed share of debt.

The importance of obtained results lies in the fact the estimates of WACC for analyzed natural monopolies are carried out for the first time in such way and that they can serve as a basis for further expert analysis in regulatory processes. These processes include calculation of network tariffs in real terms grounded on a fair rate

of return, which would enable indispensable new investments in electricity and gas networks

A validity of the obtained results could be challenged by comparing them with values of nominal pre-tax WACC in some other European countries with similar financial and economic development (Fig. 9). A range between the most and the least risky activities follows the same pattern as in authors' results (when Version 2 is taken into account for electricity distribution and transmission). Regarding the WACC values for respective activities the amounts are quite similar. The only significant difference is in a case of gas distribution. However, here it is important to emphasise that in the estimates data for GPZ were taken. GPZ as stated earlier does not have any dept component (contrary to some other gas distributers in Croatia) which has a reflection on WACC whose level is above average level in ERRA countries (gas distribution companies have a gearing above zero).

Fig. 9: Pre-tax WACC in ERRA countries



Source: ERRA, 2009

Discussion and conclusion

A key part of the paper is calculation of WACC for four monopoly activities based on the provisions of the energy laws and the by-laws in a form of tariff systems that are currently in force. The importance of this calculation and consequently of the analy-

sis carried out in the paper lies in a fact that an up-to-date regulatory practice does not envisage a transparent and consistent procedure for setting the WACC, neither in a form of a well-grounded methodology for estimating WACC nor in a form of a publically available data published by the CERA or energy undertakings. Although such regulatory practice does not leave much space for an expert analysis and an academic challenge of the applied WACC per se, it, however, leaves much space for an academic challenge of a regulatory policy and methodology as a whole.

From a regulatory policy point of view, network tariffs are still administratively set without a precedent thorough and deep analysis founded on economic and technical grounds. Looking from a long term perspective such situation is financially unsustainable and unsecure for indispensable investments in such capital intensive activities, primarily in electricity transmission and distribution as well as in gas distribution. Foreign investments which are essential in energy sector, especially in deficiency of domestic investment, are negligible. This is in particular evident in the gas distribution. Although some of the gas distributors have been privatized, there is still a lack of investments due to an uncertainty in price and regulatory policies.

From a methodological point of view, the regulatory methodology set in the tariff systems needs further developments and improvements. If leaving other elements of a methodology aside (e.g. operating expenditures, regulated asset base etc.) and focusing solely on a method for calculating WACC and its particular parameters, there is a need for increasing understanding of WACC characteristics and meaning in regulatory methodology. The tariff systems defined WACC as a nominal post-tax WACC. Consequently, if the tariff systems' methodology is strictly followed, the results obtained for post-tax WACC (a range in between 6.01% and 8.24% and) are lower in comparison to a pre-tax WACC (a range in between 7.52% and 10.30%), as it is a case in other comparable central and eastern European countries.

However, in those countries the analysis of WACC calculations shows that in many of these cases calculations are based on proxy parameters overtaken from developed countries (EU-15). Primarily this refers to Beta which is considered as an exogenous variable. In other words it is not calculated based on a situation in a respective national or regional financial market.

In order to avoid setting a level of allowed revenue below a reasonable level, it is necessary to supplement a regulatory method with an additional tax component (e.g. include a tax in a cash flow). The other option would be to change a definition of WACC in a pre-tax WACC. Such changes in the methodology are a necessary precondition for setting a fair rate-of-return.

Finally, a calculation of WACC and estimation of its parameters is quite doubtful and challenging if there is no precedent regulatory practices whose result would be a reasoned and founded definition of each parameter and a method or a source used for its estimate. In case of authors' calculations based on their own assumptions an obvious evidence for such statement is e.g. the values obtained for a coefficient Beta.

If these values are compared to average Beta values used in a representative sample of other countries, a huge discrepancy can be noticed.

Therefore, one can say that without the respective definitions, as precise as possible, a regulatory process lacks transparency and credibility. Moreover, it increases a distrust and incomprehension of parties involved.

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